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THE TOPOGRAPHY OF AUSTRALIA

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1. THE CONTINENT

1. General

Australia is the smallest of the continents, and is situated to the southeast of that great block of land which comprises Europe, Asia and Africa. The two main belts of late topographic change traverse the Old World. One runs across Europe and Asia and constitutes the Himalaya Belt. The other surrounds the Pacific, and has resulted in the high mountains and the numberless festoon islands fringing Asia and Australia in the Western Pacific, These two belts meet in the complex region of the East Indies, and have produced the varied topography of New Guinea, But neither of them traverses Australia, which in consequence is one of the regions with least topographic variety in the world.

2. The Great Australian Peneplain

The characteristic feature of Australian topography is one of which most Australians know very little. It is the extremely large level area constituting most of Western Australia, Northern Territory and western South Australia. This is on the whole poorly supplied with rainfall, and in consequence has only a meagre population. But it comprises more than half of the continent and forms a single unit which is best described as “The Great Australian Peneplain.” It consists essentially of a rather low plateau about 1,200 feet above sea-level, built up of many diverse geological formations. Probably in Pliocene times (some two or three million years ago) it lay at sea level. It was in fact the level surface of an ancient continent which rain and rivers had eroded nearly to sea-level during perhaps a hundred million years.

Although Australia did not suffer buckling and folding as did much of Europe, Asia and America, yet (like Africa) it was subjected to broad uplifts which raised a large portion of the continent **en masse**. This **epeirogenic** movement produced the present-day peneplain of western and central Australia. In the eastern portion of the continent, more localized uplifts took place, so that real **folds** occurred in places and many **faults** (largely in a north-south direction) developed. Blocks of the earths crust were isolated and elevated to varying degrees, and most of our mountains in eastern Australia are due to the uplift of these blocks or **horsts**.

Between the western peneplain and the eastern cordillera is a region of some what lower land, which has sunk below sea-level at Lake Eyre. This can be divided into two portions - the Artesian Basin in the north and the Murray Basin in the south. They are probably due to the same broad movements which affected the rest of the continent.

If we consider the chief geological features of Australia, we find that the western peneplain consists for the most part of very ancient rocks which appear to have resisted folding

through a very large portion of geological history. It forms, in fact, one of those particularly stable portions of the earth's crust known as **coigns** or **shields**. On the other hand, the lower Murray Basin probably contains the largest deposits of Tertiary Age in the continent, and would thus appear to be a trough (or series of troughs) folded against the resistant western coign. The eastern cordillera with its deeply dissected surface exhibited in the profound gorges of the Blue (Mountain) Plateau and elsewhere has clearly been uplifted within comparatively recent geological time, If we pass further to the east, we find in the alternating deeps and ridges of the Tasman Sea the same phenomena repeated on a grander scale until we reach the profound depths of the Tonga Deep to the north of New Zealand, Here some authorities would place the "engine" or "centre of disturbance," whose uneasy movements have determined to a considerable extent the topography of Australia. At any rate it explains why ties topography on the whole becomes less and less striking as we move from east to west of Australia. There are, of course, local exceptions, but speaking generally we can say that the eastern coastlands exhibit marked juvenile topography, while the rest of Australia is more or less senile throughout. Only on the margins of the great peneplain, where rivers are busily cutting down the scarps, is there a zone of youthful rivers, and this feature is well marked near Perth and along the north coast of the continent.

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2. WESTERN AUSTRALIA

1. General

This State occupies nearly one-third of the whole continent of Australia, and forms the major portion of the great peneplain mentioned previously. As pointed out in section §1. The Continent, it was probably uplifted to a height of about 1,200 feet somewhere near the end of Pliocene times. In consequence, the erosion by rivers has been carried on rather extensively in the marginal portions where the rainfall is fairly heavy. In places this peneplain is bounded by fault scarps, and the so-called Darling Range, behind Perth, is of this type. The deep valleys of the Helena River and adjoining rivers neat Perth are thus of late origin, while the broad shallow valleys of their headwaters still show the topography of pre-uplift times. Yet in this State as elsewhere the results of recent oscillations of the land are often to be observed. Thus along the coast south of Broome the writer has noted numerous examples of **raised** beaches, while at Port Hedland, some 300 miles further south, is a **drowned** river valley somewhat resembling Port Jackson in plan.
We may consider the detailed topography in six main regions. Those are (1) Kimberley, (2) Desert, (3) North-west, (4) Swanland, (5) Salt Lake Region, (6) Nullarbor.

2. The Kimberley Region

This region differs from most of the State in that it has a rainfall exceeding 20 inches. It is, however, part of the general peneplain - consisting of many different formations which have been eroded in varying degrees. The highest point is Mount Hann (2,800 feet). With the greater rainfall, the older moderately flat surface is now broken into ridges and valleys. Some of the harder rocks stand out as steep walls, running roughly from N.W. to S.E. These in part constitute the King Leopold, Napier and Cells Ranges, and the rivers in places zig-zag through these "walls" in deep antecedent gorges. It has been suggested that the rivers originally flowed to the south-west like Sturt Creek, but have been captured by west-flowing coastal streams The main stream is the Fitzroy River, which is about 350 miles long, and carries enormous volumes of water to the sea after the summer rains. It drains broad grassy plains and occasionally, as in 1914, these are covered by floods over 20 miles wide. In the dry months it ceases to run, but long waterholes are common along its coast. The coast is marked by a number of deep narrow gulfs (rias) which are due to the relatively late drowning of large river valleys by the sea. A tidal rise of 25 feet is common on this coast.

3. The Desert Region

This division comprises the large block of uninhabited country which lies east of a line joining the De Grey River to Laverton. It extends far into South Australia and the Northern Territory. Its topography is fairly well known from the accounts of Talbot, Clarke, Carnegie, Clapp and others. The general level is about 1,500 feet, and there are topographic variations beyond shallow salt-lakes and insignificant ranges. The latter are often little more than “breakaways,” which the local geologists consider are probably the relics of the ancient valley walls eroded in a former wet epoch.

The salient features are the sand-ridges, which Carnegie describes as from 30 to 50 feet high, and running very regularly nearly east and west. Much of the region however consists of a great undulating desert of gravel, formed largely of pebbles of ferruginous sandstone. Carnegie travelled from Laverton to Hall’s Creek, i.e., through the centre of this region. Talbot describes the country along Canning’s stock route somewhat to the north-west, starting from Wiluna. Water was obtainable from wells dug some 50 feet deep, or native rock-holes, which were found at intervals of 20 miles or so “In windy weather the air is full of sand, but the sand ridges do not seem to be shifting perceptibly.” They usually carry a fairly strong growth of desert gum and “ buck’ spinifex, and sometimes some grass. Talbot is emphatic that south of Sturt’s Creek the country is never likely to be occupied by pastoralists.

A later traverse by Talbot and Clarke from Wiluna E.N.E. to the border reveals the same type of country. For 300 miles desert country consisting of sand ridges or sand plains was encountered. Occasionally “breakaways” 150 feet high were seen. To the east of the Townsend Range (long. 127° E.) broken granite ranges occurred with a belt of better country amid the desert. They saw, however, little or no probability of pastoral occupation here.

To the north-west the desert reaches the Indian Ocean at the 90-mile Beach. Here the writer found that the bare sand ridges commenced about 25 miles north of Wollal, and great streaks of red dust lay for miles over the ocean, where the constant trade wind had carried them. (This is exactly parallel to the conditions off the Sahara desert rear Cape Blanco.)

The eastern portion of this region will be considered in the sections dealing with the Northern Territory and South Australia.

4. The Northwest Division

This extends from the De Grey River to the Murchison River, and has been compared to the Punj-ab in that it also consists (with the intervening Fortescue, Ashburton and Gascoyne) of five great river basins. The country is a peneplain rising from the coast to a height of 4,000 feet at Mount Bruce. It is crossed by fault and fold scarps and merges into the sand ridge desert on the east. This region contains one of the few large areas over 3,000 feet in Australia. It is named the Hamersley-Ophthalmia Plateau, and appears to be bounded by a marked fault scarp along the north, below which flows the Fortescue River.

All the inland portion of the division consists of undulating (late mature) topography with large areas of plains, crossed by low ridges. Spinifex (**Triodia**) is the common vegetation in the Upper Ashburton and Fortescue basins, but to the south mulga is all prevailing.

The river valleys are of the nature of “wadis,” in that it is only rarely that they contain water on the surface. Thus the Shaw River had not run for nine years (in 1924), but its gravels gave a plentiful supply which was carried by train 40 miles to Port Hedland. However, at Millstream (on the Lower Fortescue) a rocky floor determines a perennial flow which is visible for several miles, until the water vanishes again in the gravels.

5. Swanland

To the temperate south-west portion of Western Australia, with a rainfall suitable for agriculture and close settlement, the name Swanland has been applied. It is a portion of the Great Peneplain which has long been actively attacked by many rivers and streams, hence the topography is somewhat different from that of the rest of the State. The western littoral is separated off by the Darling Fault Scarp, and has dropped relatively to the inland portion. This Scarp extends approximately for 200 miles from Moora southwards. The littoral has been dissected into wide shallow valleys, in which old-looking rivers meander. It consists of

clays and sands largely of fluviatile origin, which are deepest near Perth, and also of sand dunes. The littoral has later subsided, especially near Perth, and so drowned the Swan Estuary. A small upraised block appears to account for the elevated region near Cape Leeuwin. The Stirling Range is 50 miles long, and consists of quartzites which have perhaps been thrust up as an earth block to a height of 3,000 feet. This movement seems to have occurred fairly lately, since small lakes and elevated valleys still show the disturbances which disrupted the ancient drainage. King George Sound at Albany is, of course, a fine example of a drowned coastal valley.

6. The Salt Lake Division

This area lies between Swanland and the Desert Division. It has a rainfall of 8 or 10 inches, and is characterized by a great number of playas or shallow salt lakes. These are nearly all linear in shape, sometimes 50 miles long and about 5 miles wide. They occupy slight hollows in the great peneplain, and many theories have been put forward as to their origin. There is little doubt that they originated as river valleys in the wetter epochs of Tertiary times. The lakes north of Kalgoorlie (Raeside, Darlot, Salt, and Cary) appear to be dismembered portions of a river which once flowed to the south-east to Goddard's Creek, and so to the Bight. Gregory believes that these rivers were unable to keep their channels clear from encroaching sand-dunes during Post-Miocene desiccation. As Jutson shows, however, desert erosion has since affected these lakes, so that they often exhibit flat rocky floors bounded by almost vertical cliffs. Abrupt rocky islands stand out above the "billiard-table" floors.

The water in the lakes soon evaporates, but underground water can be obtained without trouble in most parts. In the south this is often salt, but in the north it is fresh, and the land, therefore, is extensively occupied by pastoralists.

7. The Nullarbor Division

This Division occupies the south-east corner of the State. It consists of a vast plateau built up of fairly late limestones. These are Cretaceous in the north, like those of the Queensland artesian basin, and are overlaid by Tertiary (Miocene) deposits in the south. The latter form the cliffs of the Bight. which are about 200 feet high. Thence, the plateau rises gradually to the north to a height of 1,000 feet. The limestone is cavernous and is often 800 feet thick. The rains sink at once into the limestone, and it is this lack of surface water which has prevented settlement on the Nullarbor Plains.

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3. THE NORTHERN TERRITORY

1. General

To a very large extent the Northern Territory forms part of the great peneplain, which as we have seen was partly uplifted in Middle or Late Tertiary times. Jensen believes that this upward movement has continued to the Present day, and is indicated by raised beaches around most of the coastline. So also the canyons of the Katherine and MacArthur Rivers show the rejuvenation of these rivers by the late uplift.

2. Inland Features

Inland the peneplain has not yet been trenched by the rivers in any general fashion. The northern part of the Territory seems to lie an elevation between 500 and 900 feet, though considerable portions of Arnhem Land (which is not yet fully explored) may he higher. The Barkly "Tableland" appears to be defined only on its northern edge where it drops somewhat rapidly towards the coast. It may be about 1,100 feet high, and much of its drainage flows into vast shallow basins. which become lakes in very wet seasons. Thus, Lake DeBurgh (near Brunette Downs) may expand to a length of about 100 miles, though generally disintegrated into a series of swampy areas at the lower ends of Playford, Creswell, and other Creeks. Lake Woods (near Newcastle Waters) is another such lake,

(probably due to a slight warp in the crust). which at present has almost vanished.

3. Coastal Rivers

The coastal rivers carry great bodies of water during the summer rains. Boats drawing 3 feet can penetrate 100 miles up the Victoria River, while the Adelaide and Roper will carry much larger craft about the same distance. In dry seasons these rivers become largely estuarine, but springs at their heads give rise to considerable bodies of fresh water even in the winter “dry” season.

4. The Southern Area

The southern portion of the Territory differs considerably from the northern. It is both higher and drier than the latter. South of Powell's Creek and the Barkly Tableland there is a great expanse of little known country, though the route along the overland telegraph is often traversed. To the west, is the north-east extension of the western desert (between Tanami and Barrow Creek) to the east is the smaller but equally unpopulated area to which the name Arunta Desert has been assigned.

These unattractive regions are more or less vegetated by mulga shrubs and by clumps of spinifex. They exhibit characteristic features of arid erosion, such as large areas of sand-dunes (usually fixed by vegetation), which run from north-west to south. east or thereabouts. There are also stretches of stony plains, and occasionally sandy valleys and bare clay-pans.

5. The Macdonnell Ranges

The Macdonnell Ranges differ a good deal in topography from the remainder of the Territory. Keith Ward has described the vicinity of Alice Springs in some detail.

“The (Mesozoic) sea retreated from continental Australia, and throughout the tertiary period to the present day, the interior of Australia has been subject to continuous sub-aerial denudation. The Mesozoic rocks on elevation above sea level formed a broad plateau region . . . and at the present time the remnants of this plateau slope gently towards the Lake Eyre depression, whither the drainage trends. . . The peneplanation of the Macdonnell Ranges was followed by an uplift which rejuvenated the streams. They cut down steep-sided gaps through the ridges of hard quartzite which were gradually etched out in strong relief. Sometimes these gaps (as at Temple Bar) are determined by the position of fault fractures.”

The Finke River is the chief watercourse from the Macdonnell Ranges. It flows to the south-east, but rises north of the chief range in the Burt Plain at a height of 2,400 feet. It then cuts through the edges of the upturned Paleozoic strata as described above. Normally the channel is occupied by long stretches of white sand devoid of surface water, separated at rare intervals by short lengths of where water may be flowing gently over a rocky bed. In heavy floods the Finke reaches Lake Eyre.

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4. SOUTH AUSTRALIA

1. General

This State has a rather diversified topography, which can best be considered in some half dozen separate regions. In the north-west is the south-eastern extension of the Great Peneplain. It is dominated by the residuals forming the Musgrave Ranges. To the south-west is the greater part of the Nullarbor Plains, which. as we have seen, extend into Western Australia. The eastern portion of the State has been much less stable, and the major topographic features are due to the very late buckling which has produced the Flinders Range, and also led to the chain of lakes surrounding this range.

2. The Southern Area

The southern part of the State is marked by the development of three peninsulas and three gulfs, which constitute a type of coastline not found in any other part of Australia. The series runs as follows: Eyre’s Peninsula (buttressed by the Gawler Ranges), Spencer’s Gulf, Yorke Peninsula, St. Vincent Gulf, Fleurieu Peninsula (ending in Cape Jervis, but,

structurally prolonged into Kangaroo Island), and the Murray Outlet Gulf. The latter has largely been silted by the immense deposits of alluvial brought down by the Murray.

3. The North West

R. L. Jack has given us a valuable discussion of the topography in the north-west of the State. The fairly level-bedded cretaceous rocks of the eastern portion have been subjected to induration of the surface by the action of the sun and infrequent rains on the siliceous rocks. The hard capping thus formed tends to break down in the form of table-top hills, and ultimately the hard fragments constitute the “gibbers” of the stony plains. Wind-blown dunes are common near the Alberga River, but after the paleozoic rocks to the west are reached, the elevation of the peneplain gradually increases (to the north-westward) from 1,000 to 2,000 feet.

The Musgrave Ranges are divided into separate hills by tide valleys which are about 2,200 feet above the sea. Still higher rise the rougher hills of granite and gneiss, of which Mount Woodroffe (about 5.000 feet) is the highest. The Everard Ranges, to the south, consist of low rounded hills rising into domes above the peneplain, which is here about 1,700 feet above sea level.

4. Evolution of South Australian Topography

In various papers Howchin has discussed the evolution of the topography of South Australia. He shows from the geological evidence that the Mount Lofty Ranges did not exist until Pliocene times, when a great continental uplift occurred. The main divide in South Australia was probably much farther north than it is today, and the coast extended much farther South. Great north-south valleys developed, possibly leading the drainage of the Macdonnells and Musgraves to the south by way of what later became the large gulfs already noted.

Relics of this stage of erosion are found throughout the Ranges in the form of flat-topped hills now about 1,500 feet high, from which rise residuals such as Mount Lofty (2,334 feet). This plateau-like area later broke into crustal blocks in the south, while apparently a vast downward buckle occurred in the northern portion of the area. As a result we find a series of ranges running north and south, flanked by **graben** (or fault-valleys) now largely occupied by the sea.

If we examine the chain of lakes which extends from the head of Spencer’s Gulf right round to Lake Frome, it is seen that very little depression would extend the gulf right round nearly to Broken Hill. From the head of the Gulf, a chain of swamps and lagoons rising only about 100 feet in 40 miles, leads to the vast salty expanse of Lake Torrens. This is 150 miles long, and is separated from the Lake Eyre depression by a ridge only 175 feet above sea level. Lake Eyre is 39 feet below sea level, and flanked by ancient lake-terraces which have been briefly examined by Halligan. Between Lake Eyre and Lake Gregory there are stony rises only about 100 feet high. Thence there are sand.hills about 25 feet high, separating the last lake from Lake Blanche, which at times connects with Lake Callabonna by floods in the Strzelecki Creek. A channel joins Lake Frome to Lake Callabonna, and the two latter are practically at the same level. There seems little doubt that this horseshoe series of lakes has developed in a semi-circular depression which accompanied the upward folding and faulting producing the Flinders Range. The latter rises sharply to 3,470 feet in Mount Benbonyathe right above Lake Frome while St. Mary’s Peak (also in this northern portion of the horst blocks) overlooks Lake Torrens from a height of 3,900 feet.

No better proof of the recency of these uplifts of the order of 2,000 feet could be desired than that available at Orroroo. Here we have relics of a vast river system. probably rivalling the Murray, which once drained the south-west and reached the sea near the head of St. Vincent’s Gulf. The Pasmore and Siccus Rivers are filled with hundreds of feet of alluvial. At Orroroo near the summit of the ranges to-day a bore penetrated 591 feet of river sands and gravel without reaching bedrock. It is clear that these gravel deposits have been buckled up to form the divide only recently, for they must rapidly disappear under the attacks of normal erosion.

The Mount Lofty Ranges are bounded by fault scarps, which appear as a series of “steps” on both flanks of the uplands. Howchin shows that there is a remarkable series of such

fragmentary blocks in the Adelaide district. Thus, the Upper Sturt flows on a surface about 1,900 feet above the sea. Belair, nearer the coast, is on a broken portion of the same peneplain, now about 1,000 feet above the sea; Burnside is on a fragment some 500 feet high. Under Adelaide are sunken areas at 220 feet and 2,000 feet (?) below sea level.
The lower Murray River has very little fall (only 57 feet) while flowing through South Australia. It seems likely that its original path has been much changed by the late Tertiary uplift. The sharp angle at Morgan is suggestive in this connection. The river flows through a wide senile valley to Overland Corner (half way from Renmark to Morgan). and then passes between well marked culls, showing that fairly recent uplift of the order of several hundred feet has affected the ancient valley.

5. Mount Gambier

In the extreme south-east of the State are the low volcanic cones (600 to 700 feet) of Mount Gambler. A number of small lakes, usually due to subsidence, are associated with the cones. It seems probable that their water supply is derived from permeable beds extending well into Victoria.

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5. QUEENSLAND

1. General

The State can be divided broadly into two regions, the Western Lowlands largely consisting of the plains covering the Artesian water-bearing beds, and the Eastern Cordillera, which extends in a belt some 200 miles wide along the coast. There are, however, several subdivisions.

2. Selwyn Upland

To the west of Cloncurry is a belt of uplands, including, the Selwyn Range, which consists of ancient rocks forming the boundary of the Mesozoic Artesian Series. These rocks are on the whole siliceous and mineral bearing, and contain such well-known fields as Mount Isa and Duchess. They form part of the main Divide, but consist in places of meridional ridges running more or less across the Divide. Towards Camooweal occur interesting **dolines** (or deep hollows) in the porous massive limestones. The Golf rivers rise in perennial streams flowing from similar limestones.

3. Great Artesian Basin

This well-defined geological feature extends into four States, but more than half of the total area is in Queensland. The water-bearing layer is at varying depths; outcropping on the east along the Divide, and sinking to 1,000 feet below the surface, near Blackall on the Barcoo River. There is another localized depression over 3,500 feet deep near Mungindi. (These deeply seated waters flow out to the surface along the western edge of the basin, in the form of hundreds of mound springs, especially between Lake Frome and Oodnadatta).

The surface of this region is a vast plain almost wholly below 1,000 feet. Indeed, except along the eastern margin, nearly all of it is below 500 feet, but near Kynuna an east-west belt forms a low ridge (above 500 feet) right across the northern part of the basin. Other lower ridges separate from each other the broad alluvial-filled valleys of the Diamantina, Thomson, and Baron. These rivers flow only after heavy rains, but in flood time they are many miles wide.

4.The (So-called) Dividing Range

In connexion with the Queensland Highlands, which form part of the Eastern Cordillera, it may be well to discuss the so-called “Great Dividing Range,” which is so prominent a feature on most maps. This belt of highlands undoubtedly constitutes the divide between the coastal drainage and that flowing westward to Lake Eyre or the Murray mouth. But, if we examine it at all closely, it is seen to be in no sense a range, but is for the most part a series of disconnected elements of very diverse origin.

In Queensland, it is only an important feature where formed of basalt flows of comparatively late date. Between these it is often a mere warp-ridge but a few hundred feet above the general level.

In the north of New South Wales the Divide is more definite for 100 miles, for here it runs along the great New England granite massif. But the Liverpool Ranges - a quite late geological formation - deviate it to the west. Here the Divide deteriorates to a mere water parting (at Cassius) between the Goulburn and Talbagar Rivers, where crustal folding, combined with the cutting action of the Goulburn, has driven the Divide far to the west. The “range” is not 2,000 feet high hereabouts.

The Divide returns along the southern rim of the Goulburn Valley towards the coast, and is then carried southwards by a series of indefinite ranges, consisting here of basalt flows, there of recent folds; and again, as at Cooma, with hardly any apparent elevation at all. Hereabouts we notice that Lake George is perched right on the Divide, while Merigan Creek flows right through the so-called Divide. Near Cooma it enters on an extraordinary zig-zag path, which points to recent interruptions in the drainage. These zig-zags around the heads of the Snowy and Tambo Rivers are almost certainly the results of important river captures. Finally, in Victoria, the great area of Pliocene basalt in the west of the State has certainly flooded pre-existing lowlands and valleys, and converted portions of them into the modern Divide.

5. The Eastern Cordillera

Lying parallel to the modern Divide, and in the north considerably to the east of it, is another belt of highlands almost coincident with the coastline These coast ranges are formed of an almost continuous series of granite masses, which reach from Tasmania to Cape York. South of Queensland the modern basalt. tapped Divide and the granite masses are mingled to a greater degree. This broad “complex” of highlands of varying origin forms a fairly well marked belt to which the name Eastern Cordillera is here applied

6. The Queensland Highlands

In the far north of this belt is one of the most interesting elevated regions in Australia. The Atherton Plateau is almost the only tropical plateau worthy of the name. No other large areas over 2,000 feet exist in our tropical areas except right on the Tropic itself at a comparatively high latitude. Furthermore, the Atherton Plateau is well-watered, fertile, and rich in minerals, and it bulks largely, therefore, in discussions of tropical settlement. Its area (over 2,000 feet) is, however, only about 15,000 square miles out of a total of 1,149,320 square miles in tropical Australia. The plateau rises gradually to the east, the summit being Mount Bartle Frere (5,438 feet), the highest point in Queensland. This mountain rises almost straight up from a narrow coastal plain. It stands right in the path of the constant trade winds, and its flanks are drenched with rains, amounting to 165 inches at Harvey Greek, This factor, combined with the recency of the uplift, has led to very rapid headward erosion by such coastal streams as the Barton, Johnstone, Mulgrave &c. The headwaters of the Mitchell, which rises right on the east coast, have accordingly been captured by the Barren River. Fine waterfalls are common, and the scenery stands out among Australian

examples.

The coast has been subjected to many oscillations in recent times. A series of coastal plains of very recent origin points to an upward “joggle”. The great gorges and waterfalls also show evidence of some hundreds of feet uplift many thousand years ago. But the dominant feature is subsidence. The coral reefs of the Great Barrier probably form only a veneer of a few hundred feet on a subsided coastal margin. The festoon islands so common along the coast also clearly indicate dominant subsidence.

The Clarke Range near Mackay has only a restricted area over 2,000 feet. Some of the basalt tablelands along the Great Divide (eg., Buckland Tableland) rise to about this same level. A number of small lakes just north of the Tropic, e.g., Buchanan, Galilee, Dunn, and Mueller, seem to he relics of ancient rivers running across time present Divide. Perhaps the present Burdekin formerly drained westward into the Thomson River, via these depressions. Lake Galilee is about 20 miles long, and there is only a divide of 200 feet separating it front Belyando River.

The Darling Downs area is also largely composed of basalt. Small portions rise above 2,000 feet. The coastal rivers are shifting the divide to the west, and steep slopes flank the east of these uplands. A series of late tertiary volcanic cones constitutes the Glass House Mountains. Somewhat similar cones are found in the Peak Range farther north. Much field work remains to be done in Queensland before the topography can he adequately described, as very little investigation has been attempted away from the coastlands.

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6. NEW SOUTH WALES

1. General

Owing to the work of David, Andrews, Sussmilch, and others, the topography of this State is fairly well known. The major divisions resemble those of Queensland. There is a low western region - not, however, in general covering artesian water as in Queensland - and a mountainous eastern division extending almost to the coastline. Several subdivisions may usefully be employed.

A. Western Division (Lowland)
- Northern Artesian Basin.
- Broken Hill Buckle.
- Cobar Buckle.
- Riverina or Murray Basin.

B. Eastern Division (Highland)
- New England
- Blue Plateau.
- Kosciusko and the Monaro.

Associated with the latter division are small coastal plains; such as those near the Clarence, Hunter, and Hawkesbury Rivers.

2. Western Division

(i) **Lowlands**. With regard to the lowland portions of the west, there is not much difference in the topography of the northern (Artesian) region and the southern (Riverina) region. Both exhibit senile valleys choked with alluvial, and so level that they merge into plains with

indistinguishable divides. Thus the Paroo river in time of flood is stated to spread to a width of some 20 miles. Probably much of the alluvial is a legacy of larger rivers of the Pleistocene period. Some uplift has affected the main streams in places. Thus, at Walgett, the Darling (or Barwon) flows in a trench 30 feet below the alluvial plains. The same condition obtains at Wilcannia. The soil consists largely of black **chernozem** near the rivers, with much humus and unoxidized fragments of basic rocks. Older alluvial tends to be reddish arid less “sticky” owing partly to oxidization.

The southern boundary of the Artesian Division is not marked by any notable surface feature. It runs from Bourke to Dubbo near the Bogan River. On the east, the land rises rapidly to the outlying spurs of the New England Plateau. The Artesian water is found at much shallower depths than in Queensland - on an average about 1,800 feet down. (The deepest, Boronga Bore, near Mungindi, penetrates to a depth of 4,338 feet).

(ii) **Central District**. The central portion of New South Wales exhibits three low earth waves, which probably originated in pressure from the New Zealand area exerted on the mobile crust thrusting it against the Great Australian Shield. We have already considered the Flinders Range - the most western of these buckles. To the east lie the Broken Hill Uplands, the Cobar Peneplain, and the Blue Plateau. Those bear marks of recency and probably date from the Pleistocene or “Kosciusko” period.

(iii) **The Broken Hill Upland**. The Broken Hill Upland (rather inaccurately named the Barrier Ranges) consists of a horst some 100 miles long and 30 miles wide. It rises some 500 feet above the alluvial plains, which in turn are 500 feet above the sea. The upland is crossed by low ridges, which represent the edges of upturned resistant strata. Well-marked fault-scarps cut by deep gorges appear along the western edge. Large delta-fairs of an earlier wetter cycle run far out on the alluvial deposits of the Frome Plain.

(iv) **The Darling River***.* The Darling River flows from the Northern (Artesian) Division to the Southern (Riverina) Division of the lowlands. No marked rejuvenation of the river seems to have ensued due to the buckling here, for at Wilcannia the Darling is only entrenched about 30 feet in its alluvials.

(v) **The Cobar Peneplain***.* The Cobar Peneplain is an area some 200 miles wide of early Paleozoic rocks rising about 600 feet above the sea, and so only a little higher than the surrounding deep alluvial plains. It represents fairly closely the pre-uplift topography of most of Eastern Australia in middle tertiary times. The level area around Wyalong to the south is of somewhat the same topography.

(vi) **The Riverina or Murray Basin***.* The Riverina Region extends from about Narrandera westwards to the border of South Australia. It is characterized by extremely level conditions, so that the rivers have the habit of delta-streams and distributaries are common. In local floods the water at times flows **upstream**. Billabongs and anabranches cross from river to river. Willandra Billabong in periods of flood connects the Lachlan near Hillston with the Murray at Euston. So also Yanco Creek joins the Murrumbidgee with the Murray by an alternative channel, to the south of the main drainage of the region (via Hay). Local uplift has caused the Murray to be slightly rejuvenated in its Echuca section, but very little work has been done on the topography of the Murray.

3. Eastern Division

(i) **The New England Plateau**. New England is the most extensive plateau in Australia, though not the highest. If covers an area about 200 miles long by 40 miles wide all over 3,000 feet high. Three bosses between Armidale and Tenterfield (Ben Lomond, Capoompeta, and Chandler’s Peak) rise to 5,000 feet, while an important high spur, called

Snowy Mountain, runs to the east, and the “Barrington Tops” to the south are about the same height. Andrews writes of New England, “The conception which harmonizes must with the facts of observation appears to be that the main New England Plateau surface was developed by erosive activities near sea level, and that it has since been raised unevenly, so as to form a warped and faulted surface.” There are three of these plateau levels. The Coyra Peneplain is at about 4,300 feet elevation, the Mole Peneplain is at 4,000, the Sandon and Stannifer Peneplain at about 3,200 feet. The coastal rivers have cut back into tilts uplifted region and have formed canyons (as at the head of the Macleay) some 3,000 feet deep.

Three volcanic groups are associated with New England. The Nandewar group of trachyte cones rises to a height of 4,000 feet between Armidale and Narrabri. A similar group to the south of Narrabri is called the Warrumbungles. Its highest point is about 3,000 feet. Linking these to the main plateau is the basalt-capped highland called the Liverpool Range.

A very marked topographic feature lies just to the south of this group of highlands. It is the **Cassilis Gate**, and is a broad gap, well below 2,000 feet. It is the most striking break in the highlands from the latitude of Brisbane to that of Melbourne. Curiously enough, no railway so far takes advantage of this topographic advantage for a route to the west. The depression is due partly to tectonic and partly to erosional factors.

(ii) **The Blue Plateau**. The next massif to the south is the Blue Plateau. (The term “Blue Mountains” is a misnomer. It consists of a boldly warped portion of the crust, which has been elevated three or four thousand feet. The main flexure is along the western bank of the lower Nepean River, and here the surface rises sharply about 1,000 feet. But several other parallel folds further west bring the ancient peneplain surface to a height of over 4,000 feet at Mount Bindo (near Jenolan).

Marked faults have accompanied the folding. Near Kurrajong, a fault scarp of about 500 feet is a marked feature, and similar faults are probably common to the southward. The uplift dates back many thousand years, and marked rejuvenation and reversal of the streams is the result, It seems likely that the pre-uplift drainage here was to the north-west or north, as suggested in 1911 by the writer. Such courses are still dominant in the Wianamatta “Stillstand” (or region of negligible uplift) which lies between Sydney and the Blue Plateau. Field work being carried out at present seems to support the view that the Wollondilly and Cox Rivers originally joined the Macquarie streams to the north west. The remarkably broad and deep gorges cut in the plateau, with their unique bottle-necks, where they pass through the “hinge” of the earth fold, are due to the presence of a hard horizontal sandstone capping softer coal measures. They have been described elsewhere.

(iii) **The Lake George Gate**. An area of marked faulting separates the Blue Plateau from the next massif to the south. To this area of relatively low faulted topography the name of Lake George Gate has been given. Here the former tributaries of the Yass River and other streams have been ponded back by meridional faults to form lakes like Lake George (20 miles long) and Lake Bathurst. Fine “antecedent” gorges such as the Molonglo (east of Canberra) and the Murrumbidgee (as it flows west through the horst) at Burrinjack show the relative recency of the Kosciusko uplift.

(iv) **Kosciusko and the Monaro**. The south-east corner of New South Wales contains the highest mountains in Australia. Kosciusko rises to 7,328 feet, but it is merely the summit of a crustal block or horst with a general level of five or six thousand feet. The topography of the Kosciusko Plateau has been worked out in some detail. Glacial relics of the Pleistocene ice age, such as moraines and cirques, only occur within about 10 miles of the summit, at elevations over 5,500 feet. Sussmilch has shown that the courses of the Murrumbidgee and Snowy Rivers near Kosciusko have been largely determined by the presence of **graben**

bounded by meridional faults.

It seems probable that a “lineament” (or line of crustal weakness) extends from Canberra southwards, perhaps to Bass Strait. The late Mr. Dannevig charted a deep submarine canyon or drowned river valley near Cape Everard, which was perhaps the southern end of this lineament. Evidences of capture are common along the courses of the Upper Murrumbidgee and of the Snowy River in this district. This lineament traverses the Monaro Plateau, which probably constitutes another crustal block parallel to the Kosciusko horst. but at a level of about 2,500 feet. It is bounded on tine east by a marked scarp, by which travellers descend rapidly to the coast. The linear and character of the coast from Cape Howe north to Bateman’s Bay indicates that faulting has played a part here. A similar coastline from the Shoalhaven northward nearly to Sydney is also probably largely determined by faulting. The term “Illawarra Range” for this faulted feature is, therefore, a misnomer and should be replaced by “Illawarra Scarp.”

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7. VICTORIA

1. General

The topography of Victoria may be considered in three major divisions. The **Eastern Highlands** are structurally associated with those of south-east New South Wales. The **Northern Plains** are merely portion of the Murray Basin which we have already considered. In the south-east of the State is a fairly level low area which has been termed the **Great Valley** of Victoria.

2. The Eastern Highlands

The marked chance in the direction of the main axis of the cordillera near Kosciusko is of much interest. Yet the Victorian highlands, like those in the south-east of New South Wales, appear also to be built up of meridional bursts arranged parallel to each other right across Victoria. The highest "blocks" are to the east, and Mounts Bogong (6,508) and Hotham (6,100) are not much lower than Kosciusko itself. The chief gap hereabouts is the Omeo “ Gate,” which separates the Victorian portion of the Kosciusko massif (with the Cobboras (6,000) and Mount Gibbo) from the Bogong Plateau. The Mitta and Tambo valleys here apparently form a "lineament" across the highlands. Lake Omeo is on this line of weakness, and the Tambo headwaters appear largely to have been captured by the Upper Mitta.

3. The Dargo High Plains

The Dargo High Plains are at about 4,500 feet elevation, and he to the south of Mount Bogong. Mount Buffalo (5,645 feet) extends to the north, raising fairly abruptly above the Murray Plains. The edges of this elevated peneplain have been deeply notched by the rivers to north and south. The Goulburn has cot a deep wide valley and has had a varied history involving several captures. Eastward the highlands are somewhat lower, hot Mounts Howitt and Wellington are over 6,000 feet. Further east again the divide becomes more ridge-like and rapidly drops from Mount Torbreck (4,995 feet) to the Kilmore "Gate," where it is only about 1,000 feet above sea-level.

The elevated portion of the State to the west of this Gate also consists of a peneplain in general sloping from Mount Macedon (3,324) to the south-west. The level is about 2,000 feet at Ballarat, 1,000 at Ararat and 600 at Hamilton. Fault scarps, similar in origin and direction to those described near Kosciusko, define the Pyrenees (3,240) and Grampians (3,827). These latter seem to be hunts above the general level of the elevated peneplain.

4. The Great Victorian Valley

The whole of the Western Plains south of the divide (in the west) has been flooded by basalt lavas. This region between Ballarat and the Otway Ranges (of Jurassic strata some 1,900 feet high) is part of the Great Victorian Valley. It is about 500 feet above sea-level. Small volcanic cones are common throughout, such as Mount Elephant (1,294 feet), Mount Noorat, and Tower Hill. Lakes are scattered over this basalt plain, occupying depressions in the fairly lately formed surface Port Phillip would appear to he a sunken portion of the Great Valley, which, structurally, extends to the east as the Gippsland Plains. Here the Strzelecki Ranges arc of the same type and age as the Otway Ranges. On Wilson's Promontory are isolated granite hills reaching 2,434 feet.

5. The North West Plains

The north-west of the State consists of a vast plain mostly below 500 feet and covered with alluvial deposited by the tributaries of the Murray, These latter in general end blindly in a maze of sand-hills, for the rainfall is Only 12 inches a year. The Murray has a large enough supply to flow continuously in dry years like 1914 or 1923, hut the Wimmera, Yarriambiack, and Avoca Rivers have too little catchment. Numerous swampy lakes, like Hindmarsh and Tyrrell. have developed where the tributaries end.

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8. TASMANIA

1. General

This State, like the adjacent region on the mainland, consists essentially of lower Paleozoic sediments buttressed by granite. But over a large portion of the centre and east a basin in the Paleozoic rocks has been filled with coal measures (ads allied deposits), and these again have been overwhelmed with basic eruptive reeks.

2. The Central Plateau

The dominant feature is the central plateau, which falls from a general level of 3,500 feet in the north-west towards the south-east, being drained by the Derwent system. This plateau seems to be a horst, the lowlands to the north and east having been relatively depressed by step faulting, which has left boll scarps (locally called tiers).

Along the western edge the plateau rises to considerable heights in Cradle Mountain (5,069), Eldon (4,789) and Frenchman's Cap while the southern wall of the Derwent basin is crowned by Mount Field West (4,725) and Mount Wellington (4,166). The northern rim is also high (Ironstone 4,736), but the east of the plateau is much lower and connects at Oatlands (1,350) with the east coast highlands.

3. North-east and South-west Massifs

Two somewhat isolated massifa lie in the north-east and south-west respectively. The highest point in the State is Legge's Peak (5,160) on the rectangular plateau of Ben Lomond. This is bounded on the west by the lowland drained by the Tamar and its tributaries. In the south-west of the Island, the Huon River flows parallel to the Gordon, Tamar and Derwent. These river-directions probably indicate the prevalence of lineaments across the plateaux forming Tasmania. The Wilmot and Arthur highlands in the south-west are probably outlying portions of the same uplifted peneplain. Their summits are about

3,500 feet above the sea.

4. Evidences of Late Elevation

The deep gorges of the western rivers (e.g., King, Franklin and Denison), time large lakes on the central plateau (e.g., Great Lake, Arthur and Sorell), and the truncated east coast (as at St. Mary's where the South Esk rises on the coastal rim) are all features pointing to the comparatively late development-of the present topography of Tasmania. Moraines and other relics of the glacial age have been described as occurring on Cradle Mountain, Mount Field, Mount Anne and other peaks.

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